— HYDRO QUAL, INC. —

REC'D 9-22-92
F.B.

PROPOSED PAWTUXET RIVER SEDIMENT SAMPLING PROGRAM - FOR MODELING

Goals

The sediments of the Pawtuxet river in the vicinity of the CIBA-GEIGY facility are characterized by significant variability in physical characteristics and contaminant concentrations. In order to calibrate and apply the water quality model being developed for this site it is necessary to quantitatively characterize the spatial distribution of contaminant concentrations. Such quantification requires a sampling density greater than that employed in Phase 1 and detection limits lower than those attained in Phase 1.

In addition to quantifying the longitudinal and lateral concentration gradients, the vertical concentration profile must be defined. Because of the temporal variability in contaminant loading to the river, the contaminant concentrations in the sediment will vary with depth. Surficial sediments (top 2 to 10 cm) actively interact with the water column and are the habitat of epi-benthic and infaunal organisms. Contaminants associated with these sediments have a direct impact on water column contaminant concentrations and sediment toxicity. Contaminants associated with deeper sediments have a more limited impact that occurs by way of diffusion through the interstitial water to the surficial layer. However, they may be scoured up during extreme flow events.

The model will operationally divide the sediment bed into two categories: cohesive and non-cohesive. Cohesive sediments are defined as those sediments having a median particle diameter less than 250 μm and containing greater than 15 percent silt and clay sized particles. These sediments also tend to have high total organic carbon (TOC) concentrations. Sediments defined as non-cohesive include areas having low and high TOC concentrations. Since the organic carbon content of the sediment is a determinant of the ability of the sediment to sorb organic contaminants, the non-cohesive sediments have been sub-divided into high and low TOC areas using a TOC of 1 percent as the dividing line. Average contaminant concentrations for each of the sediment types are necessary for the model.

Thus, the sediment sampling program has two goals. The first of these is to quantitatively define the longitudinal, lateral and vertical contaminant concentration gradients that exist within the study area. The second is to determine the differences in concentration between sediments characterized as cohesive, high TOC non-cohesive and low TOC non-cohesive.

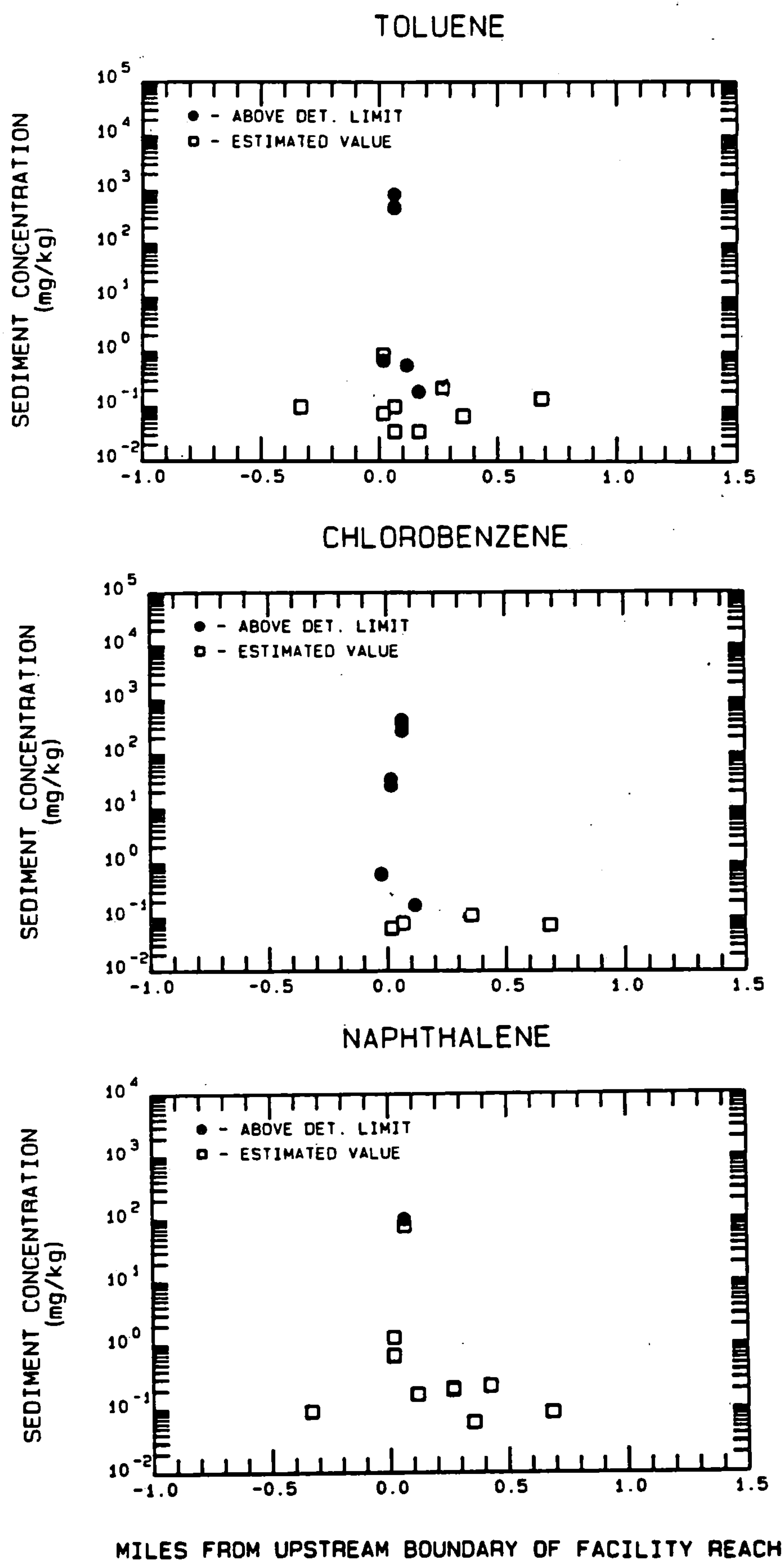
Sampling Strategy

The sediment bed within the study area has been divided into a 360 element grid for modeling purposes. This grid includes 6 lateral divisions and 60 longitudinal divisions. Using data from the recently completed sediment characterization study, each of these elements has been designated as containing cohesive or non-cohesive sediments. From a modeling perspective, the ideal sampling program would be directed to defining an average contaminant concentration for each grid element. Such a program is not logistically or financially feasible, nor is it technically necessary. By sampling within a subset of the grid elements, concentrations in unsampled elements may be interpolated based on concentration gradients and relevant physical characteristics such as sediment type and TOC content. VERIFICATION

WHAT IS SIZE OF EACH GRID?

The Phase I data indicate that the greatest spatial variability in sediment contaminant concentrations exists adjacent to the CIBA-GEIGY facility. As illustrated for toluene, chlorobenzene and naphthalene in Figure 1, concentrations in this area of the river range over four to five orders of magnitude, with highest concentrations in the area of the former coffer dam. Much of this variability appears to be related to both sediment type and proximity to the coffer dam. The limited data in the reaches above and below the facility show much lower concentration gradients. Consequently, quantitative characterization of the spatial concentration gradients requires that the majority of the sampling effort be confined to the facility reach.

A total of 51 grid elements or sampling areas have been chosen. Reflecting the spatial concentration gradients, 27 of these areas are within the 0.4 mile facility reach, 9



PAWTUXET RIVER RCRA PHASE I
SEDIMENT ORGANIC CHEMICALS DATA, 1990-1991

FIGURE 1.

are in the 3 mile upstream reach and 15 are in the 1 mile downstream reach. The sampling densities for the facility, upstream and downstream reaches are 68, 3 and 15 areas per mile, respectively. Since the highest contaminant concentrations and the greatest contaminant concentration variability are expected in the cohesive sediment areas, all of the cohesive sediment areas are included. The non-cohesive areas are approximately equally divided among high and low TOC elements. The distribution of sampling areas among the sediment types is shown in Table 1. Maps indicating the locations of the sampling areas within each of the reaches are presented as Appendix 1 and coordinates digitized from these maps are presented in Table 2.

TABLE 1. DISTRIBUTION OF SAMPLING AREAS			
	Number of Sampling Areas		
Reach	Cohesive Sediment	High TOC Non-Cohesive Sediment	Low TOC Non-Cohesive Sediment
Upstream	1	5	3
Facility	15	6	6
Downstream	8	4	3

Quantification of average concentrations within a grid element requires multiple samples. Five sediment samples will be collected from random locations within each element or area. As a means of minimizing cost, all samples taken within a sampling area will be composited.

THIS MEANS THAT THE ACTUAL CONTAMINATION COULD BE 5 TIMES WHAT IS FOUND IN THE COMPOSITE DUE TO THE POTENTIAL FOR 4 OF THE COMPOSITES TO SHOW NO CONTAMINATION & 1 WOULD SHOW SOME CONTAM

TABLE 2A. SAMPLING LOCATIONS IN AREAS CHARACTERIZED BY COHESIVE SEDIMENTS									
Easting	Northing	Easting	Northing	Easting	Northing	Easting	Northing	Easting	Northing
521967.6	247181.7	522019.0	247198.4	522075.3	247217.1	522125.1	247234.3	522170.8	247250.8
523898.9	248432.2	523919.9	248465.7	523940.9	248507.5	523963.7	248550.2	523988.3	248594.6
524020.8	248650.8	524040.8	248674.5	524061.1	248700.2	524081.8	248724.8	524104.0	248752.9
523943.4	248708.7	523965.5	248740.6	523988.1	248768.2	524009.8	248795.7	524030.8	248823.4
524135.2	248790.3	524153.1	248806.8	524173.2	248823.9	524192.7	248839.4	524215.2	248854.8
524250.5	248874.9	524271.8	248885.0	524291.8	248895.2	524313.1	248905.1	524337.6	248915.8
524376.7	248928.4	524403.2	248934.3	524426.8	248939.3	524451.7	248944.4	524481.8	248948.9
524662.4	249050.7	524689.1	249060.1	524714.6	249068.2	524737.1	249077.1	524762.1	249085.8
524655.9	249063.9	524686.4	249072.3	524713.1	249082.2	524735.7	249091.9	524759.2	249099.5
524792.1	249112.8	524819.0	249123.8	524842.6	249134.1	524869.3	249143.6	524895.6	249156.0
524966.7	249103.5	524988.4	249114.8	525010.9	249129.7	525038.4	249144.7	525064.3	249157.8
524960.3	249121.7	524980.8	249133.2	525003.4	249148.3	525033.4	249161.3	525058.1	249174.8
525104.4	249175.4	525130.5	249180.9	525156.4	249186.3	525187.8	249192.0	525217.1	249196.4
525101.1	249190.4	525131.1	249198.4	525161.0	249204.1	525185.9	249208.4	525212.1	249213.4
525387.3	249287.7	525415.6	249292.4	525444.9	249301.2	525471.7	249308.7	525495.8	249316.7

TABLE 2A. SAMPLING LOCATIONS IN AREAS CHARACTERIZED BY COHESIVE SEDIMENTS									
Easting	Northing	Easting	Northing	Easting	Northing	Easting	Northing	Easting	Northing
526623.9	248958.2	526648.6	248943.1	526673.4	248925.8	526706.6	248907.4	526740.1	248886.5
526679.2	249024.1	526697.8	249008.4	526721.3	248995.9	526747.1	248980.8	526771.5	248968.1
528189.8	249086.6	528230.2	249062.2	528264.1	249037.3	528285.0	249002.8	528301.1	248973.2
528312.3	248928.6	528311.8	248898.8	528313.5	248875.6	528312.4	248846.1	528312.9	248823.9
528314.5	248781.1	528310.6	248744.6	528304.4	248700.2	528303.7	248646.9	528302.7	248592.2
529105.1	247910.1	529162.8	247900.5	529233.8	247889.1	529288.3	247884.1	529340.6	247881.2
529397.1	247896.9	529439.4	247917.7	529479.4	247950.3	529508.4	247979.1	529545.4	248017.3

TABLE 2B. SAMPLING LOCATIONS IN AREAS CHARACTERIZED BY HIGH TOC, NON-COHEISVE SEDIMENTS									
Easting	Northing	Easting	Northing	Easting	Northing	Easting	Northing	Easting	Northing
519913.4	247178.0	519951.2	247207.2	519983.5	247233.1	520026.5	247263.3	520062.5	247291.7
516123.4	245780.4	516160.8	245807.1	516187.5	245834.3	516203.8	245864.3	516222.1	245899.1
515967.4	244528.4	515971.2	244566.8	515974.5	244613.2	515977.6	244658.1	515981.8	244695.4
521950.3	247207.3	522004.5	247230.9	522061.9	247252.8	522108.4	247271.5	522157.0	247290.9
523818.3	248489.8	523841.3	248531.2	523863.9	248568.8	523888.9	248611.7	523909.1	248652.3
523987.7	248675.5	524007.0	248705.6	524031.4	248737.3	524053.7	248763.9	524070.7	248786.4
524082.6	248851.9	524103.9	248867.8	524124.0	248885.7	524146.5	248900.9	524171.2	248921.2
524072.8	248866.3	524094.9	248885.0	524115.0	248902.1	524136.9	248917.0	524162.2	248936.2
524680.6	248975.9	524708.2	248983.7	524735.5	248993.6	524757.8	249001.5	524782.3	249014.1
525546.7	249236.0	525574.0	249243.0	525600.6	249249.5	525627.1	249256.4	525661.0	249261.8
526252.1	249330.2	526278.1	249329.5	526307.4	249319.8	526333.3	249306.3	526354.5	249293.0
527561.7	249365.8	527602.6	249330.4	527657.7	249288.4	527706.9	249268.2	527753.7	249250.2
527580.4	249411.9	527630.9	249381.5	527690.9	249345.2	527741.6	249317.8	527788.8	249297.2
529391.3	248037.2	529444.8	248062.1	529485.9	248088.1	529516.4	248116.9	529549.6	248150.9

TABLE 2C. SAMPLING LOCATIONS IN AREAS CHARACTERIZED BY LOW TOC, NON-COHESIVE SEDIMENTS									
Easting	Northing	Easting	Northing	Easting	Northing	Easting	Northing	Easting	Northing
516150.3	245739.0	516190.8	245774.1	516212.1	245803.8	516237.5	245835.2	516258.3	245873.2
515053.2	243130.1	515093.0	243111.0	515135.3	243098.9	515175.8	243090.6	515225.8	243089.9
523861.6	248461.2	523885.4	248507.0	523906.0	248541.7	523926.6	248583.1	523948.6	248621.8
523955.8	248700.7	523976.7	248728.3	524000.9	248758.6	524021.2	248785.1	524043.1	248811.3
524108.3	248822.6	524132.4	248840.9	524151.5	248856.6	524174.4	248872.2	524197.3	248888.5
524358.8	249005.6	524382.9	249010.1	524409.9	249015.3	524437.2	249019.4	524467.1	249026.1
524516.4	248985.0	524543.4	248991.9	524569.5	248996.0	524600.1	249003.2	524626.2	249007.5
525543.9	249275.5	525569.9	249280.6	525592.8	249284.7	525617.8	249289.8	525647.1	249294.2
525852.4	249328.2	525890.0	249337.8	525919.9	249345.2	525958.4	249352.2	525990.3	249361.5
527572.4	249383.3	527617.8	249354.9	527679.5	249318.1	527727.5	249295.9	527768.2	249272.9
528349.0	248784.5	528349.2	248738.8	528350.2	248701.2	528347.8	248647.7	528348.6	248596.1

Sampling Procedures and Sample Analyses

Sampling locations listed in Table 2 and shown on the enclosed map have been selected based on sediment characteristics (TOC and grain size). Approximately half of the locations selected for coring are in fine grained, high TOC areas. Hopefully this will increase the success rate of obtaining cores. Where possible, push cores will be used to obtain samples to a depth of at least 40 centimeters. Vibra-coring techniques will be tried where push cores are unsuccessful. The classification of sampling locations as cohesive, high TOC - noncohesive or low TOC - noncohesive may provide a basis for assessing the appropriate coring technique (push or vibra-core). Core tubes will be sealed as quickly as possible after collection to minimize exposure of the sediment sample to oxygen.

In areas where cores can not be collected, grab samples from approximately the upper 5 centimeters will be collected. The volume of sample collected will be sufficient to fill the sample container and eliminate any headspace of air in the sample container.

Water temperature and depth of water at the sample location will be recorded.

A visual characterization of the surficial sediment of each core will be noted. Cores will then be sectioned vertically as indicated in Table 3.

TABLE 3.

Interval	Depth (cm)
1	0 - 5
2	5 - 10
3	10 - 20
4	20 - 30
5	30 - 40

Like depth intervals from the five cores from each sampling area will be composited. A separate study will be conducted in advance of the sediment sampling program to evaluate the appropriateness of compositing samples that will be analyzed for volatile organics.

The proposed analyses for the composite samples are listed in Table 4 with detection limits for the chemicals to be modeled.

TABLE 4.	
Analyses Total Solids Fraction (weight of dry sample/weight of wet sample) pH Organic Carbon Acid Volatile Sulfide	
	Detection Limit (mg/kg)
Chlorobenzene	0.01
Toluene	0.01
Naphthalene	0.01
PCB congeners (mono through deca)	0.10
Tinuvin 328	0.15
Simultaneously Extracted Metals	
Zinc	0.30
Copper	0.30
Silver	0.50

In one sampling area in the facility reach additional shallow cores will be collected for determination of pore water concentrations. Nine 4 inch cores, sixteen 3 inch cores or twenty two 2.5 inch cores will be collected and the top 5 centimeters composited. A bulk subsample will be analyzed in accordance with Table 4, and the remainder will be centrifuged. The centrate will be analyzed for the metals and organics listed in Table 4, as well as organic carbon.

HydroQual, Inc.

CONSULTANTS IN WATER POLLUTION CONTROL

Rec'd
9-22-92
F.B.

TRANSMITTAL

TO: U.S. Environmental Protection Agency
Waste Management Building
90 Canal Street
Boston, Massachusetts 02114

DATE: September 18, 1992

FILE: CIBA0010

ATTENTION: Mr. Frank Battaglia

RE:

WE ARE SENDING YOU __X__ HEREWITH ______ UNDER SEPARATE COVER VIA

copy of "Proposed Pawtuxet River Sediment Sampling Program."

THE ABOVE ARE FOR YOUR __X__ INFORMATION ______ APPROVAL

______ AS REQUESTED ______ OTHER

REMARKS:

IF ENCLOSURES ARE NOT AS NOTED, PLEASE NOTIFY US AT ONCE.

Edward J. Garland

EJG/lm